DEC STD 176-1 Printed-Wiring Board Repair Criteria

DOCUMENT IDENTIFIER: A-DS-EL00176-01-0000 Rev E, 11-Nov-1992

ABSTRACT: This standard defines allowable repairs and criteria for rigid printed-wiring boards (PWBs) fabricated by or purchased for Digital Equipment Corporation.

APPLICABILITY: It is mandatory that printed-wiring boards (PWBs) fabricated by Digital manufacturing facilities or purchased from qualified suppliers meet or exceed all applicable specifications found in this standard unless modified by related Digital engineering drawings and specifications.

STATUS: APPROVED 11-Nov-1992; use VTX SMC for current status.

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1 INTRODUCTION

This standard defines allowable repairs and criteria for effective repairs performed on rigid printed-wiring boards (PWBs) fabricated by or purchased for Digital Equipment Corporation.

Within the context of this document, repair and rework are defined as follows.

repair: The act of restoring the functional capabilities of a defective (nonconforming) part without necessarily restoring appearance and uniformity.

rework: The act of repeating (part of or all) one or more manufacturing operation(s) for the purpose of improving the yield of acceptable product and process. The product reworked shall meet all requirements of applicable drawings, customer specifications and expectations, bill of materials, and intended use. The product must maintain uniformity, interchangeability, and appearance of non-reworked product.

1.1 SCOPE

This standard provides a general overview of typical PWB repairs that can be made by PWB fabricators, and the criteria to be applied when repairs are made to a product that has limited functional or limited cosmetic compliance to the standards contained in *EL-SM176-00, Printed-Wiring Board Manual*.

This standard does not apply to printed-wiring board technologies under development where the quality or reliability of the repairs have not been determined.

This standard does not describe specific equipment, techniques, or other procedural details needed to perform allowable repairs. PWB fabricators are allowed a degree of flexibility depending on the kind of technology and the kind of repair to develop individual repair procedures and techniques in accordance with the requirements specified in this standard and the appropriate sections of DEC STD 176.

This standard does not provide requirements for nonconforming products requiring major process rework, such as improper plating thickness and alloy, plating adhesion, soldermask rework, and so forth. Following such rework, each PWB must meet all product safety, electrical, mechanical, cosmetic, cleanliness, and workmanship requirements specified in EL-SM176-00.

1.2 RESPONSIBILITIES

All internal organizations involved with the fabrication and use of PWBs are responsible for understanding and complying to the requirements in this standard, and for providing information to keep the standard up-to-date.

1.2.1 Suppliers

All suppliers under contract to produce PWBs for Digital Equipment Corporation must comply with the requirements of this standard.

1.2.2 Printed-Wiring Board Standards Committee

Refer to EL-SM176-00 for more information.

2 ALLOWABLE REPAIRS

Digital internal personnel and Digital external supplier personnel may perform the following PWB repairs unless specified otherwise in Digital product documentation.

a. Restorations of base laminate
b. Removal of hole obstructions (PTH)
c. Removal of surface contaminants
d. Removal of surface shorts
e. Repair of opens on outer layers
f. Repair of opens on nonlaminated inner layers
g. Repair of shorts on inner layers
h. Replacement and repair of damaged fingers
i. Repairs of soldermask
j. Other (see text under subhead 5.9 for more information)

3 RELIABILITY

All repairs performed on PWBs fabricated by or purchased for Digital Equipment Corporation must meet all applicable reliability requirements and Quality Assurance tests specified by the appropriate section of DEC STD 176 and in documents referenced by the appropriate section of DEC STD 176. The PWB supplier's responsibility is to ensure reliability of all internally and externally repaired products.

The following tests should be performed to assess and ensure reliability of repairs (All are contained in IPC-TM-650 *IPC Test Methods Manual - Section Two: Test Methods for Printed-Wiring Boards*

a. Plating adhesion—subhead 2.4.1
b. Thickness, plating in holes—subhead 2.2.13
c. Peel strength—subhead 2.4.8
d. Tensile strength and elongation—subhead 2.4.18
e. Flexural strength of rigid PWB—subhead 2.4.4
f. Thermal stress (solder float)—subhead 2.6.8
g. Porosity of gold plating—subhead 2.3.24
h. Current carrying capacity—subhead 2.5.4
i. Interconnection resistance—subhead 2.5.12

Note: An *unrepaired* sample representative of the *normal* PWB fabrication process should be included with repaired samples to provide a reference or control.

4 PRODUCT SAFETY

The product safety requirements for recognition of Digital PWBs are specified in *DEC STD 176-2 Printed-Wiring Board Product Safety Criteria*. All supplied boards must meet or exceed these requirements. It is critical that repairs performed on Digital PWBs do not adversely affect applicable product safety and Underwriters Laboratories (UL) requirements.

5 REPAIR OVERVIEW AND CRITERIA

This heading provides a general overview of typical PWB repairs and specifies the criteria to be applied when repairing a nonconforming product. Repair limitations based on product safety, reliability, and PWB technology are supplied where applicable. Adherence to the following criteria ensures that subsequent repairs have the appropriate quality and reliability required by the appropriate section of DEC STD 176.

5.1 BASE LAMINATE RESTORATIONS

Base laminate restorations are repairs that involve restoring damaged base laminate to an original strength condition. The allowable repair and criteria to be applied are described in the following sections.

5.1.1 Extra Holes

Certain extra holes may be acceptable without repair. Refer to the appropriate section of DEC STD 176. Unacceptable extra holes created by random fabrication errors may be repaired as follows.

1. Remove surface pads and all plating in the hole.
2. Clean and fill the hole with epoxy resin.
3. Cure and trim excess epoxy resin flush to laminate surface.
4. Repair surface circuitry (shorts and opens). See text under subheads 5.4 and 5.5.
5. Apply and cure permanent soldermask coating.

The repair of extra holes must meet the following criteria.

a. Repaired holes must have no adverse electrical or signal transmission effect on the PWB.

b. Repaired holes must be capable of remaining functionally and cosmetically intact after solder float test. See text under heading 3, Reliability.

5.1.2 Damaged or Missing Holes—Nonplated-Through Holes

Missing component and via plated-through holes are not repairable; conductive rivets or *griplets* are not allowed. Minor damage or obstruction to these holes may be repairable (see text under subhead 5.2). Certain degrees of damage to nonplated-through holes may be acceptable without repair. Refer to the appropriate section of DEC STD 176. Unacceptably damaged or missing nonplated-through holes such as handle, screw, fastener, tooling holes, and so forth, may be repaired as follows.

1. Clean damaged area and fill hole with epoxy resin.
2. Cure and trim excess epoxy resin flush to laminate surface.
3. Locate and drill small diameter pilot hole and verify positional location to applicable mechanical drawing (MD) print tolerance.

NOTE

Positional location tolerances less than +0.010 inch (0.25 mm) may require *secondary* drilling on a numerically controlled (N/C) drill machine to achieve acceptable results. The repair of damaged or missing nonplated-through holes must meet the following criteria.

a. **Repaired holes must have no adverse electrical or signal transmission effect on the PWB.**

b. **Repaired hole diameter and positional location must meet MD print and tolerances specified in the appropriate section of DEC STD 176.**

c. **Repaired holes must be capable of remaining functionally and cosmetically intact after solder float test. See text under heading 3, Reliability.**

4. If acceptable, drill out pilot hole with appropriate diameter drill and verify diameter and positional location to applicable MD print tolerances.

5.1.3 Laminate Damage or Imperfections

Certain degrees of laminate damage or imperfections such as delamination, warpage, weave exposure, measling, haloing, chips, cracks, pits, dents, and edge damage may be acceptable without repair. Refer to the appropriate section of DEC STD 176.

Unacceptable damage and imperfections that are not repairable are as follows.

a. Weave exposure, measling, haloing, and cracks in unacceptable degrees of delamination

b. Chips, pits, dents, and edge damage larger than 0.250 inch (6.35 mm) in any direction

c. Pits, dents, or other indentations whose depth has unacceptably altered the dielectric spacing between internal layers

Chips, pits, dents, warpage, and edge damage less than or equal to 0.250 inch (6.35 mm) in any direction, and whose depth does not affect dielectric spacing of internal layers, may be repaired as follows.

1. Remove unwanted and foreign materials so that clear access to base laminate is obtained.
2. Clean damaged area and fill with epoxy resin.
3. Cure and trim excess epoxy flush to laminate surface.

4. Repair surface circuitry (shorts and opens). See text under subheads 5.4 and 5.5.

CAUTION FOR STEPS 3 AND 4

If repair to surface circuitry is involved, adequate caution is required to ensure excess epoxy is trimmed flush to laminate surface. Indentations or protrusions from the laminate surface may affect the dielectric spacing of surface circuitry to the nearest inner-layer plane, resulting in an unacceptable repair.

5.1.4 Edge Damage

Edge damage may be repaired as follows.

1. Remove and clean the damaged area back to *sound* laminate surface.
2. Reconstruct the damaged area by casting epoxy resin into a mold or fixture of suitable geometry and release properties. The design of this mold or fixture must produce a reconstructed area that after cure duplicates the base laminate thickness and texture within MD print and tolerances specified in the appropriate section of DEC STD 176. The mold or fixture also produces a slight excess of epoxy in reconstructed areas that must be trimmed back to final outline dimensions.
3. Cure epoxy, remove mold or fixture, and trim excess epoxy flush to circuit outline.
4. Apply and cure permanent soldermask coating, if necessary.
5. Verify that circuit outline after repair is within MD print and tolerances specified in the appropriate section of DEC STD 176.

5.1.5 Warpage—Bow and Twist

Warpage repair is to be performed per text under subhead 7.4.2.1 of IPC-R-700, *Suggested Guidelines for Modification and Repair for Printed-Wiring Boards and Assemblies*. Verification of warpage repair according to the text under subhead 2.4.22 of IPC-TM-650, the appropriate section of DEC STD 176, or product documentation is required.

NOTE

Repair of severely warped PWBs may not be possible or practical.

Warpage repairs must meet the following criteria.

a. Repaired areas must have no adverse mechanical or electrical effect on the PWB.

b. Repaired areas must be capable of remaining functionally and cosmetically intact after solder float test. See text under heading 3, Reliability.

5.2 REMOVAL OF COMPONENT PLATED-THROUGH HOLE OBSTRUCTIONS

Via holes with plating nodules or *plugged* with solder may be acceptable without repair. Component holes with plating nodules that do not reduce the finished-hole diameter below tolerances also may be acceptable without repair. Refer to the appropriate section of DEC STD 176.

5.2.1 Plugged Component Holes

Component holes that are plugged with solder or plating nodules or obstructions reducing finished-hole size below the requirements specified within the appropriate section of DEC STD 176 may be repaired as follows.

1. Apply a drop of flux to the plugged holes.
2. Apply only enough heat to melt the solder plug, using a fine-tip soldering-iron.
3. Use *solder wick* or heated vacuum solder removal equipment to dislodge the solder plug.
4. Verify that the resulting hole diameter is within tolerance, and that all aspects of PTH quality are acceptable in the appropriate section of DEC STD 176.
5. Touch up surface pads, if necessary.

5.2.2 Nodules and Obstructions

Nodules and obstructions may be repaired as follows.

1. Remove nodules and obstructions with appropriate size drill or reamer.
2. Verify that resulting hole diameter is within tolerance, and that all aspects of PTH quality are acceptable in the appropriate section of DEC STD 176.
3. If PTH is unacceptably voided or excessively disturbs or exposes copper, scrap the PWB.
4. If a slight amount of copper is exposed, apply flux and sufficient solder to cover the exposed copper.
5. Perform plugged hole repair per text under subhead 5.2.1.

The nodule and obstruction repairs shall meet the following criteria.

a. Repaired PTH finish tolerances, plating thickness, and quality characteristics shall be as specified in the appropriate section of DEC STD 176.
b. Repaired PTH shall be capable of maintaining mechanical and functional reliability after solder float test. See text under heading 3, Reliability.

5.3 SURFACE CONTAMINANTS

Removal of surface contaminants (ionic and organic), tape residues, oxidation products, and other contaminants adversely affecting the functionality and reliability of the PWB are permitted, providing the repair process used does not degrade or adversely affect any electrical, mechanical, plating, solderability, workmanship, cleanliness, or reliability requirements specified in the appropriate section of DEC STD 176 and applicable product documentation.

5.4 SURFACE SHORTS

Surface shorts on nonlaminated inner layers or laminated product, whether solidly *bridged* (less than 5-ohms resistance) or *slivered* (5-ohms resistance or greater), may be repaired as follows.

1. Locate and gain clear access to shorted region. Remove soldermask, if necessary.

2. Physically and mechanically remove short, taking adequate precautions against excessively disturbing the base laminate surface, excessively exposing glass fiber, and reducing circuit features below minimum as specified in the appropriate section of DEC STD 176.

CAUTION

Use of electrical power (current/voltage) to burn out shorts is expressly forbidden.

3. On laminated product (not nonlaminated inner layers), solder touch-up to disturbed circuit features may be required.
4. Apply and cure soldermask permanent coating, if necessary.

Surface shorts repairs must meet the following criteria.

a. Repair must not damage base laminate, expose glass fibers, or reduce circuit feature dimensions below the minimum allowed in the appropriate section of DEC STD 176.

b. All repaired backplanes and board technologies with 15-mil and below line widths and spacings must pass automatic electrical testing prior to acceptance.

c. For board technologies with line widths and spacings greater than 15-mils or boards under short-term waiver from automatic electrical tests, the insulation resistance between previously shorted or repaired networks must be greater than 500 kilohms, (networks are isolated or open) as measured with a suitable calibrated ohmmeter.

d. The repair must meet all other electrical, mechanical, workmanship, cleanliness, and reliability requirements in the appropriate section of DEC STD 176 and applicable product documentation.

5.5 SURFACE OPENS

Surface opens on nonlaminated inner layers or laminated product, whether an actual gap or open exists (greater than 500 kilohms resistance), or a severe nick or narrowing of the conductor (greater than 5 ohms, less than 500 kilohm resistance), may be repairable, subject to the restrictions specified in the appropriate section of DEC STD 176 and product documentation.

Surface opens on controlled-impedance and capacitance products may be repairable subject to the restrictions specified in the appropriate section of DEC STD 176 and product documentation.

The only method allowed for the repair of surface opens entails a process known as Parallel Gap Resistance Welding. This process welds a piece of gold-plated KOVAR ribbon, of appropriate geometry to match the PWB etch technology, across each end of the open by passing sufficient current through both base metals (KOVAR/etch) to heat both metals to their melting point. The heat generated, in addition to applied pressure, forces an exchange of each base metal, forming an electrically and mechanically solid junction upon cooling.

CAUTION

Reflow soldering, *tack* soldering, or any method involving soldering is not allowed.

5.5.1 Repair Criteria for Surface Opens

The following criteria for an acceptable repair must be met prior to performing the actual repair.

a. The maximum specified width of any conductor to be repaired is 0.125 inch (3.18 mm).

b. Areas to be repaired are no closer than 0.031 inch (0.79 mm) to pad features or fingers.

c. For noncontrolled impedance and noncapacitance products, the maximum length of any open to be repaired is 0.500 inch (12.7 mm).

d. For controlled impedance and capacitance products, the maximum length of any open to be repaired is 0.050 inch (1.27 mm).

e. For controlled impedance and capacitance products, the maximum length of the repair wire welded across an open, meeting the restriction of item d, is 0.150 inch (3.81 mm).

f. For noncontrolled impedance and noncapacitance products, the nominal geometry (width/height) of the repair wire used must result in the repair meeting the minimum line width/spacing specified in the appropriate section of DEC STD 176 and product documentation for the applicable PWB technology.

g. For controlled impedance and capacitance products, the nominal geometry of the repair wire used must be within ±0.0005 inch (.01 mm) of the nominal width of the etch conductor to be repaired.

h. The maximum number of opens repairs per etch conductor equals one.

i. For controlled impedance and capacitance products, the maximum number of opens repairs per layer equals three, including finger replacement. See text under subhead 5.7.

j. For controlled impedance and capacitance products, repairs that are parallel and adjacent on the same layer surface within 0.200 inch (5.08 mm) are not allowed.

k. For controlled impedance and capacitance products, repairs that are at the same X-Y coordinate location on adjacent layers (Z axis) are not allowed.

5.5.2 Repair of Surface Opens

Surface opens that meet the criteria in the text under subhead 5.5.1 of this document may be repaired as follows.

1. Remove soldermask, if necessary, or otherwise gain clear access to the repair area.
2. Trim unbonded ends of the open to permanently bonded etch. Remove solder from both ends of permanently bonded etch in the area to be welded. Proper welds are made to a copper surface of bonded etch only.
3. Position the appropriate size gold or KOVAR wire and weld to each end of the open. Exercise adequate caution in positioning the wire and performing the weld to ensure that line width and/or spacing and disturbance of base laminate is within acceptable limits in the appropriate section of DEC STD 176.
4. A visible weld line free of cracks or voids must exist completely across the gold or KOVAR wire.
5. The resistance of a repaired conductor shall be no greater than 10% above that of an unrepaired conductor of the same geometry and length.
6. Verify that weld repair does not short to adjacent networks by ensuring that the insulation resistance between adjacent networks and the repaired network exceeds 500 kilohms when measured with a suitable calibrated ohmmeter.
7. If acceptable, completely cover all exposed copper, gold, or KOVAR in the weld area on outer layers only with solder, then encapsulate the weld area with epoxy resin.
8. Do not solder inner layers. Encapsulate weld areas with epoxy resin not exceeding 0.003 inch (0.076 mm) in thickness.
9. Apply and cure permanent soldermask coating on outer-layer weld areas only, if necessary.
10. All repaired PWB technologies of 15-mil or smaller line widths and/or spacings must pass automatic electrical testing prior to acceptance. The above criteria are sufficient for PWB technologies with line widths and/or spacings greater than 15 mils.
11. Verify all repairs on impedance and capacitance per specification.

Repaired surface opens must meet the following criteria.

a. Line geometry (width, height, spacings) and disturbances of laminate surface must meet the requirements of EL-SM176-00 and product documentation.

b. Peel and tensile strength of weld area must meet or exceed strength of nonrepaired conductor. See text under heading 3, Reliability.

c. Repair must not create any adverse electrical or mechanical effects on the PWB.

d. Repair must be capable of remaining electrically, mechanically, and cosmetically intact after solder float test. See text under heading 3, Reliability.

5.6 INNER-LAYER SHORTS—LAMINATED PRODUCTS

If the repair of inner-layer shorts involves welding surface conductors as part of the repair, the prerepair criteria specified in the text under subhead 5.5.1 must be met.

For multisignal-layer (MSL) products, the density and complexity of the inner-layer circuitry in relation to the shorted area may make the repair impractical or impossible per the requirements below. Inner-layer shorts repair for applicable products is permitted as follows.

1. Pinpoint exact physical location of short by radiographic methods and ascertain feasibility of repair.

   Repair is feasible if there is clear access for physically and mechanically removing the short without creating opens on neighboring circuitry, or creating unacceptable damage to plated-through holes or other inner-layer features in the appropriate section of DEC STD 176 and product documentation.

2. Gain clear access to the shorted location by removing soldermask and surface obstructions.

3. Remove the short physically and mechanically by a practical method (drilling, milling, routing), exercising adequate caution to avoid creating opens on any adjacent networks (in X, Y, or Z axes) or excessive damage to plated-through holes or other inner-layer features.

CAUTION

Use of electrical power (voltage/current) to *burn out* shorts is forbidden.

4. Check the removal of the short by ensuring that a minimum resistance of 500 kilohms exists between repaired networks as measured with a suitable calibrated ohm-meter.

   Verify that no opens were created by ensuring that a maximum of 5-ohms resistance exists between nodes on adjacent networks.

5. Fill all holes, slots, or depressions created in the repair process with epoxy resin.

6. Cure and trim excess epoxy resin flush to base laminated surface.

7. Perform repairs to surface circuitry, if necessary, according to text under subheads 5.4 and 5.5 of this document.

8. Apply and cure permanent soldermask coating, if necessary.

9. Retest continuity of all repaired product on automatic electrical tester.

10. Verify that impedance and capacitance are within applicable specifications.

Repair of inner-layer shorts on applicable laminated product must meet the following criteria.

a. Repair must not have any adverse electrical, mechanical, or reliability effects on the PWB.

b. Repair must be capable of remaining electrically, mechanically, and cosmetically intact after solder float test. See text under heading 3, Reliability.

5.7 CONNECTOR CONTACT FINGERS

Some imperfections on gold contact fingers may be allowable without repair. Refer to the appropriate section of DEC STD 176 for criteria. Unacceptable finger defects may be repaired, providing the resultant repair meets all applicable requirements in the appropriate section of DEC STD 176. Fingers that cannot be acceptably repaired according to the appropriate section of DEC STD 176 may be replaced. Gold-plated pads (0.080-inch-square) are replaceable following the procedures under subhead 5.7.1 and 5.7.2. Refer to drawing number D-MD-ELEN626-00-DBU, E-MD-ELEN625-00-DBU, and D-MD-ELEN624-00-DBU contained in EL-ENPCB-01, *PC Board Engineering Handbook—Standard Circuit and Finger Details.* For the repair of backplane solder connector contact pads, refer to process under subhead 5.7.3.

5.7.1 Repair of Gold Contact Fingers

The repair of gold contact fingers follows.

1. Remove the gold and nickel-plating layers to clean, base copper. This may be done by chemical, electrolytic, or mechanical abrasion, providing the method chosen does not degrade or adversely affect the base laminate, surface finish, and adhesion of the remaining copper beyond what is in the requirements of the appropriate section of DEC STD 176.
2. If the defect cuts deeply into the copper, replace the finger; otherwise, remove only enough material to eliminate the defect. Exercise adequate precaution to preserve the thickness and surface finish of the copper to the requirements of the appropriate section of DEC STD 176.
3. The repair entails replating 0.000050-inch-minimum electrolytic gold over 0.000100-inch-minimum electrolytic nickel.

5.7.2 Replacement of Gold Contact Fingers

NOTE

Fingers or tabs containing plated-through holes within the finger or tab outline are not replaceable.

The replacement procedure of gold contact fingers on applicable product follows.

1. Prior to removal, lightly scribe lines in the base laminate along both edges of the finger to facilitate accurate positioning of the replacement finger.
2. Cut the etch leading to the finger to be replaced, leaving sufficient bonded etch to properly weld the etch extending from the replacement finger. (Refer to the text under subhead 5.5.1 b.).
3. Peel damaged finger and perform any base laminate restorations according to subhead 5.1, if necessary. The laminate surface must be clean, smooth, and flat, providing the proper base for the replacement finger.
4. Locate the appropriate *style* of replacement finger exactly matching that of the PWB. Replacement fingers are fabricated from material consisting of a special heat-sensitive, adhesive-backed copper foil (1-ounce minimum thickness) that has been laminated with photoresist, imaged with artwork containing all finger types used by Digital designs, and etched to resolve individual fingers that are then cut out and stored as replacement fingers. The replacement finger pattern must define the actual finger outline, inclusive of tolerances, and a sufficient length of interconnecting etch for welding purposes. (Refer to text under subhead 5.5.1 b.). See A-PS-1419258-00-0, *Copper Foil for PWBs/Adhesive Film, Sheets, and Rolls*.
5. Accurately position the replacement finger and bond to the PWB in a finger-laminating press specifically designed for finger replacement. The laminating press applies sufficient heat and pressure to melt the adhesive backing, resulting in a secure bond to the base laminate surface upon curing and cool down.
6. Reconnect the replacement finger etch to the remaining etch from step 2 by welding according to the requirements of text under subhead 5.5. Apply solder to weld area up to butt line according to the appropriate section of DEC STD 176.
7. Clean finger-to-base copper surface and replate nickel/gold up to butt line according to text under subhead 5.7.

The repairs of all connector gold contact fingers and pads must meet the following criteria.

a. The repair must not create any adverse electrical, mechanical, or reliability effects to the PWB or connector.

b. Finger dimensions, location, butt line, surface finish, porosity, plating thicknesses, plating adhesion, and overall board thickness must be within tolerances specified in the appropriate section of DEC STD 176 and product documentation.

c. Minimum peel strength of replacement fingers after solder float test must be 6.0 pound/inch of finger width. See text under heading 3, Reliability.

d. Electrical testing, where applicable, is required to ensure controlled impedance or controlled capacitance is within product specifications.

5.7.3 Rework Procedure for Removing Scratches from Backplane Solder Connector Contact Pads

NOTE

Solder connector contact pads cannot be replaced.

CAUTION

Although this process is considered simple in concept, an operator with some experience and skill in hand-soldering techniques should perform this operation.

This procedure applies to the rework of surface scratches on solder connector contact pads.

The following materials are used when performing this procedure.

a. Variable temperature soldering iron

b. Weller model EC2000 soldering station or equivalent

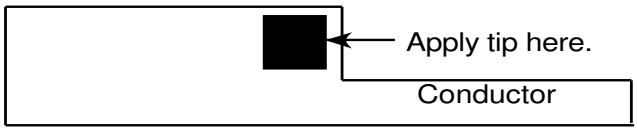
c. Weller soldering iron tip, catalog number ETA

d. Visual inspection device with 10X to 20X magnification, stereo microscope (recommended)

e. X-ray fluoroscope (to measure solder thickness)

Rework procedure:

1. Install Weller soldering iron tip on the variable temperature soldering iron.
2. Turn soldering iron ON and adjust tip temperature not to exceed 575°F + 15°F (302°C + 10°C). *Do not* tin the tip! Allow tip to oxidize (this will prevent solder from wetting the tip).
3. Adjust stereo microscope to 10X magnification and position the pad(s) to be reworked within the field of view. While viewing the pad(s) through the scope, apply soldering iron tip to end of pad as follows.



As soon as the solder on the pad reflows (melts), remove the soldering iron tip by moving it along the conductor for a short distance (approximately 1/8 inch) and lifting it away from the conductor. *Do not* lift the tip directly away from the pad as this action will produce a spur of solder projecting from the pad. The soldering iron tip shall not be in contact with the pad or conductor for longer than two seconds.

CAUTION

Right-handed operators should position pads to be reworked with conductor to the right of the pad (reverse for left-handed operator). Operators should practice on a test coupon before reworking the actual product.

4. Check that solder thickness is within specification using X-ray fluoroscopy.

NOTE

Solder thickness and quality for backplane solder connector contact pads shall meet all requirements in the appropriate section of DEC STD 176 after repair.

5.8 SOLDERMASK REPAIRS

For a given soldermask type (such as wet, dry film), voids and skips (open areas) may be repaired according to the manufacturer's approved procedures. Repairs shall meet all requirements of the appropriate section of DEC STD 176.

Extraneous soldermask may be removed by various forms of mechanical abrasion, such as knife, abrasive wheel, or microsandblaster. The process of removing soldermask shall not damage the underlying surface (such as laminate, copper, solder). The soldermask shall be completely removed leaving no residues or other forms of contamination.

5.9 OTHER REPAIRS

This document provides an overview of criteria for repairs that are *typical* or commonly used in the PWB industry. Any other *nontypical* repairs approved by IPC-R-700, *Suggested Guidelines for Modification and Repair for Printed-Wiring Boards and Assemblies* may be permitted with the approval of the responsible Digital PWB facility Quality Manager with applicable end-user waiver authorization of limited duration (90 days). All acceptability and reliability results shall be approved by the PWB Quality Group Manager. See subhead 1.3, Responsibilities.

APPENDIX A REFERENCED DOCUMENTS

A.1 Digital Documents, EL-Class

Document Number	Document Title
EL-00176-02	*DEC STD 176-2 Printed-Wiring Board Product Safety Criteria*
EL-EN624-00	*T Series VAXBI Module Finger Detail Circuit Outline*
EL-EN625-00	*F Series Printed Circuit Outline*
EL-EN626-00	*T Series VAXBI Module Finger Detail & Circuit Outline*
EL-ENPCB-01	*PC Board Engineering Handbook - Standard Circuit and Finger Details*
EL-SM176-00	*Printed-Wiring Board Manual*

A.2 Digital Documents, Other Than EL-Class

Document Number	Document Title
A-PS-1419258-00-0	*Copper Foil for PWBs/Adhesive Film, Sheets, and Rolls*

A.3 Documents External to Digital

Document Number	Document Title
IPC-R-700	*Suggested Guidelines for Modification and Repair for Printed-Wiring Boards and Assemblies*
IPC-TM-650	*IPC Test Methods Manual - Section Two: Test Methods for Printed-Wiring Boards*

A.4 Ordering Information

Use VTX SMC to order copies of EL-class documents from Standards and Methods Control. Send distribution questions to JOKUR::SMC or call DTN: 234-4423.

Following are the sources for documents not available from Standards and Methods Control.

EL-EN624-00, EL-EN625-00, and EL-EN626-00 can not be ordered individually. They can only be obtained by ordering EL-ENPCB-01 PC Board Engineering Handbook - Standard Circuit and Finger Details.

- Institute for Interconnecting and Packaging Electronic Circuits,
  7380 North Lincoln Ave., Lincolnwood IL 60646
  Telephone (708) 677-2850

APPENDIX B RELATED DOCUMENTS

B.1 Digital Documents, EL-Class

Document Number	Document Title
EL-00176-00	*DEC STD 176-0 Printed-Wiring Board Acceptance Criteria*
EL-00176-02	*DEC STD 176-2 Printed-Wiring Board Product Safety Criteria*

Use VTX SMC to order copies of EL-class documents from Standards and Methods Control. Send distribution questions to JOKUR::SMC or call DTN: 234-4423.

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